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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/043,180	01/14/2002	Naoyuki Kofuji	XA-9608	6239
7590 02/10/2004				
Miles & Stockbridge P.C. Suite 500 1751 Pinnacle Drive McLean, VA 22102-3833			EXAMINER VINH, LAN	
			ART UNIT 1765	PAPER NUMBER

DATE MAILED: 02/10/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/043,180

Applicant(s)

KOFUJI ET AL.

Examiner

Lan Vinh

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
  - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
  - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
  - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 15 December 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-41 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-41 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☒ Certified copies of the priority documents have been received in Application No. 10/043,180.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

Art Unit: 1765

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claim 1, 5, 11, 16-19, 27-28, 32, 34-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (US 6,156,663) in view of Fujii et al (US 5,110,408)

Watanabe discloses a method for plasma processing comprises the steps of:

depositing a aluminum alloy layer and a TiN layer over a substrate, depositing a patterned photoresist layer 105 at a wiring space of 0.5 microns on the TiN layer (col 7, lines 5-66), the patterned layer 20/ mask layer exposes portion of aluminum layer 18 (fig. 2 ), etching the exposed aluminum alloy layer using a plasma mixture of  $\text{BCl}_3$ ,  $\text{Cl}_2$  and  $\text{C}_x\text{H}_y\text{Cl}_z$  (each of x, y and z is 0 to 8) (col 8, lines 55-52)

Unlike the instant claimed inventions as per claims 1, 5, 11, 16, 34, Watanabe fails to disclose using  $\text{CH}_2\text{Cl}_2$ /added shape-controlling gas in the plasma mixture.

However, Fujii discloses a method for etching comprises the step of using a plasma mixture including  $\text{CH}_2\text{Cl}_2$ /shape-controlling gas to etch aluminum (col 5, lines 56-63, col 6, lines 17-18)

Since Watanabe suggests that  $\text{C}_x\text{H}_y\text{Cl}_z$ /hydrocarbon can be used in the plasma mixture to etch aluminum, one skilled in the art would have found it obvious to modify

Art Unit: 1765

Watanabe's etching step by including  $\text{CH}_2\text{Cl}_2$  in the plasma mixture because Fujii states that it is possible to use a Cl-containing hydrocarbons gas instead of the hydrocarbon gas to etch metal (col 51-57)

Regarding claims 17, 35, Watanabe discloses a semiconductor substrate 100 (col 6, lines 55-56)

The limitation of claims 18, 36 has been discussed above.

Regarding claims 19, 37, Watanabe discloses adjusting the flow ratio of the hydrocarbon gas with respect to  $\text{Cl}_2$  (col 8, lines 54-57)

Regarding claims 27, 28, Watanabe discloses mixing hydrocarbon gas  $\text{CHCl}$  with Ar (col 8, lines 59-61)

Regarding claim 32, Watanabe discloses the step of removing the protective film 106 on the sidewall (col 8, lines 14-15)

Regarding claim 39, Watanabe discloses using Ar in the plasma mixture.

3. Claims 2, 6, 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (US 6,156,663) in view of Fujii et al (US 5,110,408) and further in view of Abraham (US 4,838,992)

Watanabe as modified by Fujii has been described above. Unlike the instant claimed inventions as per claims 2, 6, 29, Watanabe and Fujii do not disclose the pressure of the plasma mixture is 0.6 Pa or greater but not greater than 1.5 Pa

Art Unit: 1765

Abraham discloses a method of etching aluminum comprises the step of etching an aluminum layer using a plasma mixture having a pressure of 5-20 mTorr (overlaps the claimed range ) (col 3, lines 20-25)

One skilled in the art would have found it obvious to modify Watanabe and Fujii by employing the gas pressure as per Abraham because according to Abraham, a plasma etching step using a gas mixture at low pressure removes all the exposed conductive material whereby virtually vertical sidewall of the conductive material are obtained (col 2, lines 10-15)

4. Claims 3, 7, 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (US 6,156,663) in view of Fujii et al (US 5,110,408) and further in view of Jolly (US 5,419,805)

Watanabe as modified by Fujii has been described above. Unlike the instant claimed inventions as per claims 3, 7, 30, Watanabe and Fujii fail to disclose that the hydrocarbon gas has a purity of 99.99% or greater.

However, Jolly, in a method of etching metal, discloses that carbon-containing gas may be obtained with high purity (col 5, lines 28-30)

Thus, one skilled in the art would have found it obvious to modify Watanabe and Fujii by employing a hydrocarbon gas having a purity of 99.99% or greater in view of Jolly's teaching because Jolly states that carbon-containing gas may be obtained with high purity for microelectronics application (col 5, lines 29-30)

Art Unit: 1765

5. Claims 4, 8, 15, 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (US 6,156,663) in view of Fujii et al (US 5,110,408) and further in view of Collins et al (US 5,300,460)

Watanabe as modified by Fujii has been described above. Unlike the instant claimed inventions as per claims 4, 8, 15, Watanabe and Fujii fail to disclose generating the plasma using electromagnetic wave within a frequency of 300 MHz to 1GHz/UHF range

Collins discloses a etching method by generating a plasma using electromagnetic wave within a frequency of 50 to 800 MHz (see abstract)

Hence, one skilled in the art would have found it obvious to modify Watanabe and Fujii by generating the plasma using electromagnetic wave within the frequency 50 to 800 MHz to maintain the sheath voltage low, so as to avoid damage to structure on the wafer as taught by Collins (see abstract)

6. Claims 9,14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (US 6,156,663) in view of Fujii et al (US 5,110,408) and further in view of Guinn et al (US 5,877,032)

Watanabe discloses a method for plasma processing comprises the steps of:

depositing a metal stack film includes an aluminum alloy layer 103, a TiN layer 102 and TiN layer 104/second TiN layer over a substrate (col 6, lines 50-55), etching the metal stack film using a plasma mixture of  $\text{BCl}_3$ ,  $\text{Cl}_2$  and  $\text{C}_x\text{H}_y\text{Cl}_z$  (each of x, y and z is 0 to 8) (col 8, lines 55-52)

Art Unit: 1765

Unlike the instant claimed inventions as per claim 9, Watanabe fails to disclose using  $\text{CH}_2\text{Cl}_2$  gas in the plasma mixture.

However, Fujii discloses a method for etching comprises the step of using a plasma mixture including  $\text{CH}_2\text{Cl}_2$  /shape-controlling gas to etch aluminum (col 5, lines 56-63, col 6, lines 17-18)

Since Watanabe suggests that  $\text{C}_x\text{H}_y\text{Cl}_z$ /hydrocarbon can be used in the plasma mixture to etch aluminum, one skilled in the art would have found it obvious to modify Watanabe's etching step by including  $\text{CH}_2\text{Cl}_2$  in the plasma mixture because Fujii states that it is possible to use a Cl-containing hydrocarbons gas instead of the hydrocarbon gas to etch metal (col 51-57)

Watanabe and Fujii fail to disclose the specific flow rate of the  $\text{CH}_2\text{Cl}_2$  gas./mole concentration of  $\text{CH}_2\text{Cl}_2$  gas.

Guinn, in a plasma etching method, discloses that a processing parameter such as flow rate is varied to change the etch rate (col 4, lines 1-5)

Thus, one skilled in the art would have found it obvious to modify Watanabe and Fujii by discovering the optimum value for the flow rate because Guinn discloses that it is a result variable in the same field of endeavor.

7. Claims 10, 20-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (US 6,156,663) in view of Fujii et al (US 5,110,408) and further in view of Davis et al (US 4,828,649)

Art Unit: 1765

Watanabe as modified by Fujii has been described above. Unlike the instant claimed inventions as per claims 10, 20, 21, Watanabe and Fujii fail to disclose the step of removing the resist mask with a plasma mixture containing F and O element

However, Davis discloses a method of etching aluminum comprises the step of removing a resist mask with a plasma mixture containing F and Oxygen (col 63, lines 39-42)

Hence, one skilled in the art would have found it obvious to modify Watanabe and Fujii by adding the step of removing a resist mask with a plasma mixture containing F and Oxygen as per Davis because Davis states that a plasma mixture containing F and Oxygen used with remote plasma improves ashing rate (col 63, lines 41-44)

Regarding claims 22-25, Watanabe discloses that the wiring has the width of 0.5 microns or less than 0.5 microns (col 7, lines 65-67)

8. Claims 12, 13, 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (US 6,156,663) in view of Fujii et al (US 5,110,408) and further in view of Takaishi (US 6,184,145)

Watanabe as modified by Fujii has been described above. Unlike the instant claimed inventions as per claims 12, 13, Watanabe and Fujii fail to disclose the step of forming over the metal film a first mask pattern at a first wiring pitch and second mask pattern at a second wiring pitch wider than the first wiring pitch.



Takaishi discloses a method of manufacturing semiconductor device using two etch patterns includes a first mask pattern at a first wiring pitch and second mask pattern at a second wiring pitch wider than the first wiring pitch (fig. 4F)

Hence, one skilled in the art would have found it obvious to modify Watanabe and Fujii by adding the step of using two etch patterns includes a first mask pattern at a first wiring pitch and second mask pattern at a second wiring pitch wider than the first wiring pitch as per Takaichi because according to Takaichi, the gate photoresist is divided into two processes by using two etch pattern, therefore, there are many flat surface gate electrode with small quantity of opening portion and the photoresist processes and the etching process become easy (col 7, lines 20-25)

9. Claims 33, 40-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (US 6,156,663) in view of Fujii et al (US 5,110,408) and further in view of Nohara et al (US 6,500,270)

Watanabe as modified by Fujii has been described above. Unlike the instant claimed inventions as per claims 33, 40, 41, Watanabe and Fujii fail to disclose the step of washing the etched metal with a solution of acetic acid and aqueous ammonia.

Nohara discloses a method for manufacturing a thin film circuit comprises the step of washing the etched metal with a solution of acetic acid and aqueous ammonia (col 4, lines 33-39)

Hence, one skilled in the art would have found it obvious to modify Watanabe and Fujii by adding the step of washing the etched metal with a solution of acetic acid and

Art Unit: 1765

aqueous ammonia as per Nohara because Nohara states that the washing composition of the invention can remove the resist film remaining after the etching easily in a short time without causing alteration such as swelling of the organic insulation (col 4, lines 49-52)

***Response to Arguments***

10. Applicant's arguments with respect to claims 1-41 have been considered but are moot in view of the new ground(s) of rejection.

**Conclusion**

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 571 272 1471.

The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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February 3, 2004